

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Poulsen et al.
Serial No.: 09/998,284
Filed: November 30, 2001
For: *Composition*

Examiner: Carlson, Karen C
Group Art Unit: 1656

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REPLY BRIEF

Appellants are appealing the rejection of claims 1-3, 9-15, 34, 35 and 40-50 from the Office Action reopening prosecution mailed on April 25, 2008. A Notice of Appeal and Appeal Brief was previously filed on February 19, 2008. An Examiner's Answer was mailed on October 15, 2008.

This reply brief replaces the original brief by responding to both the arguments in the Examiner's Answer and all other grounds of rejection covered in the original brief. Appellant requests that the rejection of these claims be reversed.

(i) Real Party in Interest

The real party of interest is Danisco A/S, the assignee of the above-captioned application.

(ii) Related Appeals and Interferences

There are no related appeals or interferences.

(iii) Status of Claims

Claims 1-3, 9-15, 34, 35 and 40-50 are pending and are being appealed. Claims 4-8, 16-33 and 36-39 are canceled. Claims 1, 49 and 50 are in independent form.

(iv) Status of Amendments

No amendments were made to the claims subsequent to the rejection mailed December 13, 2006.

(v) Summary of Claimed Subject Matter

Claim 1 relates to an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. See Abstract, page 6, lines 18-22 and page 17, lines 3-4 of the specification. The first substrate is an oligomer or a polymer of a second substrate. See page 16, lines 11-13 of the specification. The second substrate is a substrate for an oxidative enzyme, and the first enzyme is capable of generating the second substrate from the first substrate. See page 15, lines 12-16, page 16, lines 1-17 of the specification. The second enzyme is an oxidase. See page 7, line 3 and page 15, line 30 of the specification. The second enzyme generates an anti-fouling compound when acting on the second substrate. See page 15, lines 12-16 of the specification.

Claim 49 relates to a method for releasing an anti-fouling compound from a surface coating that includes incorporating in a surface coating a first enzyme, a first substrate and a second enzyme. See Abstract, page 6, lines 18-22 and page 17, lines 3-14 of the specification. The first substrate is an oligomer or a polymer of a second substrate. See page 16, lines 11-13 of the specification. The second substrate is a substrate for an oxidase enzyme, and the first enzyme generates the second substrate from the first substrate. See page 15, lines 12-16, page 16, lines 1-17 of the specification. The second enzyme is an oxidase. See page 7, line 3 and page 15, line 30 of the specification. The second enzyme generates an anti-fouling compound by acting on the second substrate. See page 15, lines 12-16 of the specification.

Claim 50 relates to a method for treating a surface of a vessel that includes applying a coating material to the surface in which the coating material includes a first enzyme, a first substrate and a second enzyme. See Abstract, page 6, lines 18-22 and page 17, lines 3-14 of the specification. The first substrate is an oligomer or a polymer of a second substrate. See page 16, lines 11-13 of the specification. The second substrate is a substrate for an oxidase enzyme, and the first enzyme generates the second substrate from the first substrate. See page 15, lines 12-16, page 16, lines 1-17 of the specification. The second enzyme is an oxidase. See page 7, line 3

and page 15, line 30 of the specification. The second enzyme generates an anti-fouling compound by acting on the second substrate. See page 15, lines 12-16 of the specification.

(vi) Grounds of Rejection to be Reviewed on Appeal

1. Whether claims 1, 11-14, 34, 35, 40, 41, 42, 44, 45, 48, 49 and 50 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al.
2. Whether claims 2, 3, 40, 43, 44 and 47 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and Hansen et al., *J. Biol. Chem.*, 272(17), p. 11581-7 (1997).
3. Whether claims 9, 10, 14, 45 and 46 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and James et al., *J. Food Biochem.*, 21, p. 1-52 (1997).
4. Whether claim 15 is unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and James et al., *J. Food Biochem.*, 21, p. 1-52 (1997) and further in view of U.S. Patent No. 5,770,188 to Hamade et al.

(vii) Arguments

1. Whether claims 1, 11-14, 34, 35, 40, 41, 42, 44, 45, 48, 49 and 50 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al.

Claims 1, 11-14, 34, 35, 40, 41, 42, 44, 45, 48, 49 and 50 have been rejected under 35 U.S.C. § 103 as being unpatentable over EP 0866103 to Hamade et al. ("Hamade"). See Office Action at p. 1-2. Claims 11-14, 34, 35, 40, 41, 42, 44, 45 and 48 depend from independent claim 1. Claims 49 and 50 are independent claims.

Appellants have discovered a sustained release of an anti-fouling compound from an anti-fouling composition. See specification at p. 4, line 24 to p. 6, line 10. This is important, since the composition will prolong the protection of the ship hull against fouling organisms which is of huge economical interest. See specification at p. 1, line 34 to p. 2, line 12. The sustained release provided by the composition is achieved by providing a coating including two enzymes and a substrate for the first enzyme. See specification at p. 6, lines 18-22. Specifically, this first

substrate is an oligomer of the second substrate and it is the conversion product of the second substrate that provides the anti-fouling compound. See specification at p. 15, lines 10-16, and p. 16, lines 11-13. The gist of Appellants' discovery is thus that the substrate whose conversion leads to the formation of an anti-fouling coating is continuously generated over a long term period, since it is formed upon conversion of an oligomeric/polymeric compound by the first enzyme. See specification at p. 16, lines 15-17, 27-29.

Claim 1 relates to an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. The first substrate is an oligomer or a polymer of a second substrate. The second substrate is a substrate for an oxidative enzyme, and the first enzyme is capable of generating the second substrate from the first substrate. The second enzyme is an oxidase. The second enzyme generates an anti-fouling compound when acting on the second substrate. Claim 49 relates to a method for releasing an anti-fouling compound from a surface coating that includes incorporating in a surface coating a first enzyme, a first substrate and a second enzyme. Claim 50 relates to a method for treating a surface of a vessel that includes applying a coating material to the surface in which the coating material includes a first enzyme, a first substrate and a second enzyme.

The Examiner alleges that "Hamade et al teach that the compound having antimicrobial activity may be a compound obtained as the direct result of enzymatic reaction between the enzyme and the substrate OR *the compound having microbial activity may be a compound formed from the product of such enzymatic reaction through further enzymatic reaction.*" (original emphasis). See Office Action at p. 2. The Examiner, on p. 10 of the Examiner's Answer, contends that in the second instance of the above-mentioned statement (in italics), "Hamade et al. teach that more than one enzyme is present in the coating composition." Further, it is "the second teaching of Hamade et al. to provide a coating composition comprising an enzyme and a substrate that will result in a product/substrate and a second enzyme will act on the product/substrate to produce an antimicrobial/antifouling compound." See Examiner's Answer at p. 11. The Examiner further concludes that "[i]t is this teaching that is the basis of all rejections in this instant application." *Id.*

MPEP 2145, paragraph X. A, states that "[a]ny judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, but so long as it takes into account

only knowledge which was within the level of ordinary skill in that art at the time the claimed invention was made and **does not include knowledge gleaned only from Appellants' disclosure**, such a reconstruction is proper" (emphasis added by Appellants) (citing *In re McLaughlin* 443 F.2d 1392, 1395 (CCPA 1971)). The Examiner's obviousness rejection of the claims violates the basic considerations of obviousness as set forth in MPEP 2141 ("[t]he references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention.").

Hamade discloses a coating composition including **one single enzyme and one single substrate**, both of which can be selected from a list of possible enzymes and substrates, respectively. See page 3, line 46 to page 5, line 53 of Hamade. Hamade does not teach or suggest any other enzyme or substrate in a coating composition. Hamade also does not provide a reasonable expectation of successfully including a second enzyme in a composition or in a surface coating or coating material. Further, the disclosure in Hamade would actually lead the skilled person away from the subject matter at claims 1, 49 and 50 because Hamade teaches that a composition with only one enzyme has an anti-fouling effect. See Example 4 of Hamade.

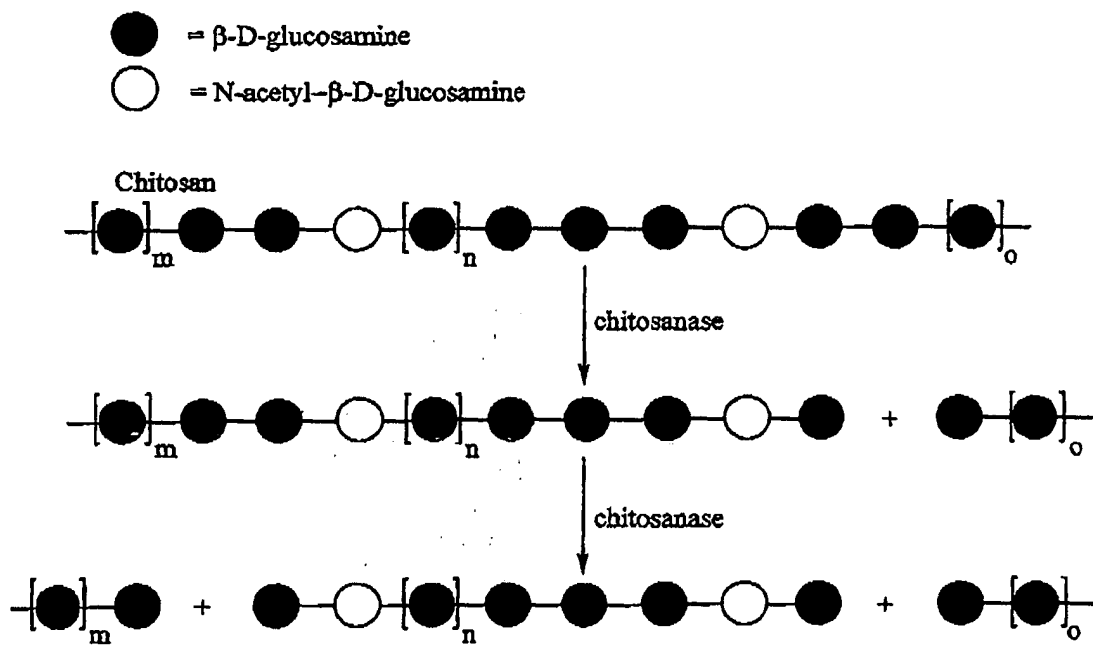
Hamade describes "a coating composition comprising a film-forming resin, an enzyme, and a substrate" See Abstract of Hamade. Hamade describes that the

the compound having antimicrobial activity is produced by enzymatic reaction *between* an enzyme and a substrate. It should be understood that said compound having antimicrobial activity may be a compound obtained as the *direct result of enzymatic reaction between the enzyme and the substrate* or a compound formed from the product of *such enzymatic reaction through further enzymatic or chemical reaction*.

See p. 3, lines 38-41 of Hamade (emphasis added). The passage refers to "further enzymatic ... reaction" and **not** the reaction of a further enzyme. The Examiner's argument that this passage teaches the use of a composition that includes more than one enzyme is inconsistent with the disclosure throughout the rest of the Hamade document which, despite disclosing a large number of different enzymes, only ever discloses one single enzyme in any of the compositions that Hamade describes. Appellants submit that the correct interpretation of the statement of Hamade at p. 3, lines 39-41, is that the passage refers to situations such as that when the compound having anti-microbial activity is formed from the decomposition products of chitosan (see p. 3, line 53 and p. 5, lines 50-53 of Hamade). As pointed out in Appellants's previous response filed October 17, 2005,

[m]ost commercial grades of Chitosan contain 75-95% glucosamine and 5025% N-acetylglucosamine units. The molecular weight of these polysaccharides can be as high as 10^6

See p. 442 of "Food Polysaccharides and their Applications" article filed with the response of October 17, 2005. Thus the reaction of a linear chitosan polymer with a chitosan-decomposing enzyme such as chitosanase may be shown diagrammatically as follows:



The initial reaction of chitosanase with chitosan results in the chitosan polymer being broken down into chitosan polymer fragments. Further enzymatic reaction of these chitosan polymer fragments with chitosanase results in these fragments being broken down into oligomeric decomposition products. Appellants submit that the "further enzymatic reaction" mentioned in Hamade relates to reactions of this type.

Further, while Hamade describes the problem of achieving controlled release of the compound having antimicrobial activity, Hamade suggests that this problem is solved merely by dispersing the enzyme and the substrate in a matrix. See page 6, lines 3-12 of Hamade. In particular, Hamade states "[i]n the present invention, the penetration of water into the matrix

occurs gradually and sustainedly so that the compound having antimicrobial activity is produced persistently at a controlled rate, thus achieving controlled release of this compound.” See page 6, lines 10-12 of Hamade. Hamade goes on to state that the problem of controlled release can be easily solved through the use of a coating composition that “comprises a film-forming resin, an enzyme, and a substrate, said enzyme being capable of reacting with said substrate to produce a compound having antimicrobial activity.” See page 6, lines 25-30 of Hamade. Thus, Hamade’s disclosure teaches away from the Appellants’ discovery as it suggests that a composition comprising an enzyme, a substrate and a film-forming resin is sufficient to overcome the problem of controlled release of the antimicrobial agent.

In contrast, the Appellants’ discovery requires the presence of a first substrate selected from oligomers and polymers of substrates for oxidative enzymes and further requires that the first enzyme reacts with an oligomer or polymeric first substrate to produce a further second substrate on which a second enzyme (an oxidase enzyme) is active. Claims 1, 49 and 50 each recite a coating including first substrate selected from oligomers and polymers of substrates for oxidative enzymes. Claims 1, 49 and 50 each recite a coating including a first enzyme. The first enzyme of the coating reacts with the oligomer or polymeric first substrate *to produce* a second substrate on which a second enzyme included in the coating material (an oxidase enzyme) is active. As Appellants have explained in the previous responses filed October 17, 2006 and September 24, 2007, the Pre-Appeal Brief Request for Review filed April 5, 2007 and the Appeal Brief filed February 19, 2008, Hamade does not provide any teaching, suggestion or motivation to include a second enzyme in an anti-fouling composition or in a surface coating or coating material.

Additionally, while Hamade provides a large list of non-limiting enzyme-substrate combinations which can generate a large number of different microbial agents (page 3, line 46 to page 5, line 53 of Hamade), no directions are given in Hamade that would lead a skilled person to select any specific type of enzyme combination over any of the others that are mentioned.

With reference to this argument, the Examiner, on p. 11 of the Examiner’s Answer, states that “[t]he combinations are all well-known in the art to produce antimicrobial agents, which is why Hamade et al. simply lists them.” The Examiner additionally states that “[t]here is no reason for Hamade et al. to teach what is well-known in the art of enzyme technology.” See p.

11 of the Examiner's Answer. Even if these combinations are well-known in the art (which Appellants do not admit that they are) as suggested by the Examiner, this still fails to provide any direction that would lead a person of skill in the art to select any specific type of enzyme combination over any of the others that are mentioned. Appellants note that Hamade suggests that all such reactions are equivalent by stating on p.3, lines 35-36 that "[t]he compound having anti-microbial activity is not restricted, provided it is produced as the result of enzyme-substrate reaction." Thus, Hamade fails to provide any directions that would lead a skilled person to select any specific type of enzyme combination over any of the many others that are mentioned. In particular there is no suggestion or motivation to use an oxidase enzyme with a substrate that is generated by the action of a first enzyme on a first substrate.

There is no suggestion or motivation in Hamade to modify the teachings of Hamade to produce an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. Therefore, contrary to the Examiner's assertions, Hamade does not teach an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. Hamade also does not teach or suggest a method for releasing an anti-fouling compound from a surface coating that includes incorporating in a surface coating a first enzyme, a first substrate and a second enzyme. Hamade further does not teach or suggest a method for treating a surface of a vessel that includes applying a coating material to the surface wherein the coating material includes a first enzyme, a first substrate and a second enzyme.

As such, claims 1, 49 and 50, and claims that depend from claim 1, are patentable over Hamade for at least the reasons described above. Appellants respectfully request reconsideration and withdrawal of this rejection.

2. Whether claims 2, 3, 40, 43, 44 and 47 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and Hansen et al., *J. Biol. Chem.*, 272(17), p. 11581-7 (1997).

Claims 2, 3, 40, 43, 44 and 47 have been rejected under 35 U.S.C. § 103 as being unpatentable over Hamade in view of Hansen et al., *J. Biol. Chem.*, 272(17), p. 11581-7 (1997)

("Hansen"). See Office Action at p. 3. Claims 2, 3, 40, 43, 44 and 47 depend from independent claim 1.

As previously described, Hamade does not teach or suggest an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. This defect is not remedied by the Hansen reference either. Hansen describes the "purification and molecular cloning of hexose oxidase from *C. crispus*, and ... the cDNA sequence of the enzyme." See p. 11581 of Hansen. Hansen does not teach or suggest an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme.

Since claims 2, 3, 40, 43, 44 and 47 depend from independent claim 1, those claims are also patentable over the combination of Hamade and Hansen for at least the reasons described above. Appellants respectfully request reconsideration and withdrawal of this rejection.

3. Whether claims 9, 10, 14, 45 and 46 are unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and James et al., *J. Food Biochem.*, 21, p. 1-52 (1997).

Claims 9, 10, 14, 45 and 46 have been rejected under 35 U.S.C. § 103 as being unpatentable over Hamade in view of James et al., *J. Food Biochem.*, 21, p. 1-52 (1997) ("James"). See Office Action at p. 4. Claims 9, 10, 14, 45 and 46 depend from independent claim 1.

As previously described, Hamade does not teach or suggest an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme. This defect is not remedied by the James reference either. James describes glucoamylases, "methods used to assay glucoamylase activity," "structural analysis of glucoamylase and main amino acids involved in catalysis and starch binding" and "the use of glucoamylase in the industry." See Abstract of James. Further, Applicants submit that a person of skill in the art would not look to the James references as James relates to the food industry. James does not teach or suggest an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme.

Since claims 9, 10, 14, 45 and 46 depend from independent claim 1, those claims are also patentable over the combination of Hamade and James for at least the reasons described above. Appellants respectfully request reconsideration and withdrawal of this rejection.

4. Whether claim 15 is unpatentable under 35 U.S.C. § 103 as being obvious over EP 0866103 to Hamade et al. and James et al., *J. Food Biochem.*, 21, p. 1-52 (1997) and further in view of U.S. Patent No. 5,770,188 to Hamade et al.

Claim 15 has been rejected under 35 U.S.C. § 103 as being unpatentable over Hamade and James and further in view of U.S. Patent No. 5,770,188 to Hamade et al. ("the '188 patent"). See Office Action at p. 5. Claim 15 depends from independent claim 1.

As previously described, Hamade and James do not teach or suggest an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme.

Such a defect is not taught or suggested by the '188 patent. The '188 patent is directed to an antifouling paint composition which includes a lipid-coated enzyme. See col. 1, lines 8-12. In a preferred aspect described in the '188 patent, the paint comprises an enzyme-susceptible resin and the lipid-coated enzyme is an enzyme capable of catalyzing the degradation of said resin. See the Summary of Invention in '188 patent. Applicants further note that all of the examples in the '188 patent use a single enzyme. As such, the '188 patent does not provide any suggestion or motivation as to solving the problem of sustained release by incorporating **two enzymes and a first substrate** to the coating composition, wherein the substrate is an oligomer/polymer compound of the second substrate. Hence, Appellants submit that the combination of Hamade and James with the teachings of the '188 patent would merely reinforce the conclusion that a composition comprising a single enzyme is sufficient. As such, there is no suggestion or motivation in Hamade, James and the '188 patent to modify the teachings of Hamade, James and/or the '188 patent to produce an anti-fouling composition that includes a surface coating material, a first enzyme, a first substrate and a second enzyme.

Since claim 15 depends from independent claim 1, claim 15 is also patentable over the combination of Hamade, James and the '188 patent for at least the reasons described above. Appellants respectfully request reconsideration and withdrawal of this rejection.

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Conclusion

The rejection of all claims should be reversed for at least the reasons given above. All claims are allowable. Should any further fees be required, please charge Deposit Account **19-4293**.

Respectfully submitted,

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(viii) Claims Appendix

1. An anti-fouling composition comprising
 - (i) a surface coating material;
 - (ii) a first enzyme and a first substrate, wherein the first substrate is an oligomer or a polymer of a second substrate, said second substrate being a substrate for an oxidative enzyme, and wherein first enzyme is capable of generating said second substrate from said first substrate; and
 - (iii) a second enzyme, wherein the second enzyme is an oxidase; and wherein said second enzyme generates an anti-fouling compound when acting on said second substrate.
2. A composition according to claim 1 wherein the oxidase is from a marine algae.
3. A composition according to claim 1 wherein the oxidase is from *Chondrus crispus*.
- Claims 4-8. (Cancelled)
9. A composition according to claim 1 wherein the first enzyme is amyloglucosidase.
10. A composition according to claim 1 wherein the first substrate is starch.
11. A composition according to claim 1 wherein the composition further comprises a binder to immobilise at least one of the constituents of the composition.

12. A coating consisting of a composition according to claim 1.

13. A coating according to claim 12 formulated for treatment of a surface selected from outdoor wood work, external surface of a central heating system, and a hull of a marine vessel.

14. A marine anti-foulant consisting of a composition according to claim 1.

15. A marine anti-foulant according to claim 14 wherein the anti-foulant is self-polishable.

Claims 16-33. (Cancelled)

34. The composition of claim 1, wherein the second substrate is a sugar.

35. The composition of claim 34, wherein the sugar is glucose.

Claims 36-39. (Cancelled)

40. The composition of claim 1, wherein the oxidase is a hexose oxidase.

41. The composition of claim 1, wherein the composition is formulated as a coating, lacquer, stain or enamel.

42. The composition of claim 1, wherein the composition further comprises a surface coating material selected from polyvinyl chloride resins in a solvent based system, chlorinated rubbers in a solvent based system, acrylic resins and methacrylate resins in solvent based or aqueous systems, vinyl chloride-vinyl acetate copolymer systems as aqueous dispersions or solvent based systems, butadiene copolymers such as butadiene-styrene rubbers, butadiene-acrylonitrile rubbers, and butadiene-styrene-acrylonitrile rubbers, drying oils such as linseed oil, alkyd resins, asphalt, epoxy resins, urethane resins, polyester resins, phenolic resins, derivatives and mixtures thereof.

43. The composition of claim 40, wherein the hexose oxidase comprises the amino acid sequence set out in SEQ ID NO: 2.

44. The composition of claim 40, wherein the hexose oxidase is obtained by cloning and expression in recombinant host organisms of a gene encoding the protein.

45. The composition of claim 1, wherein the first substrate is water insoluble.

46. The composition of claim 1, wherein the first substrate is selected from the group consisting of starch, lactose, cellulose, dextrose, peptide, inulin and mixtures thereof.

47. The composition of claim 1, wherein the oxidase is from a marine organism.

48. The composition of claim 1, wherein the first enzyme and the second enzyme are incorporated in the surface coating material.

49. A method for releasing an anti-fouling compound from a surface coating comprising incorporating in a surface coating:

(i) a first enzyme and a first substrate, wherein said first substrate is an oligomer or a polymer of a second substrate, said second substrate being a substrate for an oxidase enzyme, and wherein said first enzyme generates said second substrate from said first substrate;

(ii) a second enzyme, wherein said second enzyme is an oxidase and wherein the second enzyme generates an anti-fouling compound by acting on said second substrate.

50. A method for treating a surface of a vessel comprising applying a coating material to the surface, the coating material comprising:

(i) a first enzyme and a first substrate, wherein said first substrate is an oligomer or a polymer of a second substrate, said second substrate being a substrate for an oxidase enzyme, and wherein said first enzyme generates said second substrate from said first substrate; and

(ii) a second enzyme, wherein said second enzyme is an oxidase and wherein the second enzyme generates an anti-fouling compound by acting on said second substrate.

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(ix) Evidence Appendix

None.

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(x) Related proceedings Appendix

None.